Climate Change Impacts to Connecticut Agriculture, Infrastructure, Natural Resources and Public Health

January 21, 2010

DEP Green Team

Adaptation Subcommittee

- Public Act No. 08-98 An Act Concerning Connecticut Global Warming Solutions
- CT Climate Change Adaptation Subcommittee formed under the Governor's Steering Committee on Climate Change (GSC)
  - Agriculture workgroup
  - Natural Resources workgroup
  - Infrastructure workgroup
  - Public Health workgroup

Climate Change Projections

The United Nations Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment, released in 2007, concludes that it is "unequivocal" that the climate is warming.

Sources of Information

- New York City Panel on Climate
  - The NPCC models are based on sound science with methods developed by the Intergovernmental Panel on Climate Change (IPCC);
  - 100 mile radius of NYC
- Northeast Climate Impacts Assessment
  - Regional research projected for Connecticut
- Iterative process

The NPCC developed NYC-specific climate change projections

TABLE 1.

Baseline Climate and Mean Annual Changes[1]

Source: Columbia Center for Climate Systems Research

	Baseline 1971-2000	2020s	2050s	2080s
Air temperature Central range[2]	55°F	+ 1.5 to 3°F	+ 3 to 5°F	+ 4 to 7.5°F
Precipitation Central range[2]	46.5 in	+ 0 to 5 %	+ 0 to 10 %	+ 5 to 10 %
Sea level rise[3] Central range[2]	NA	+ 2 to 5 in	+ 7 to 12 in	+ 12 to 23 in
Rapid Ice-Melt Sea Level Rise[4]	NA	~ 5 to 10 in	~ 19 to 29 in	~ 41 to 55 in

1 Based on 16 GCMs (7 GCMs for Sea Level Rise) and 3 emissions scenarios. Baseline is 1971-2000 for temperature and precipitation and 2000-2004 for sea level rise. Data from National Weather Service (NWS) and National Oceanic and Atmospheric Administration (NOAA). Temperature data are from Central Park; precipitation data are the mean of the Central Park and La Guardia Airport values; and sea level data is from the Battery at the southern tip of Manhattan (the only location in NYC for which comprehensive historic sea level rise data are available).

2 Central range = middle 67% of values from model-based probabilities; temperatures ranges are rounded to the nearest half-degree, precipitation to the nearest 5%, and sea level rise to the nearest inch.

3 The model-based sea level rise projections may represent the range of possible outcomes less completely than the temperature and precipitation projections. See page 18 for more information.

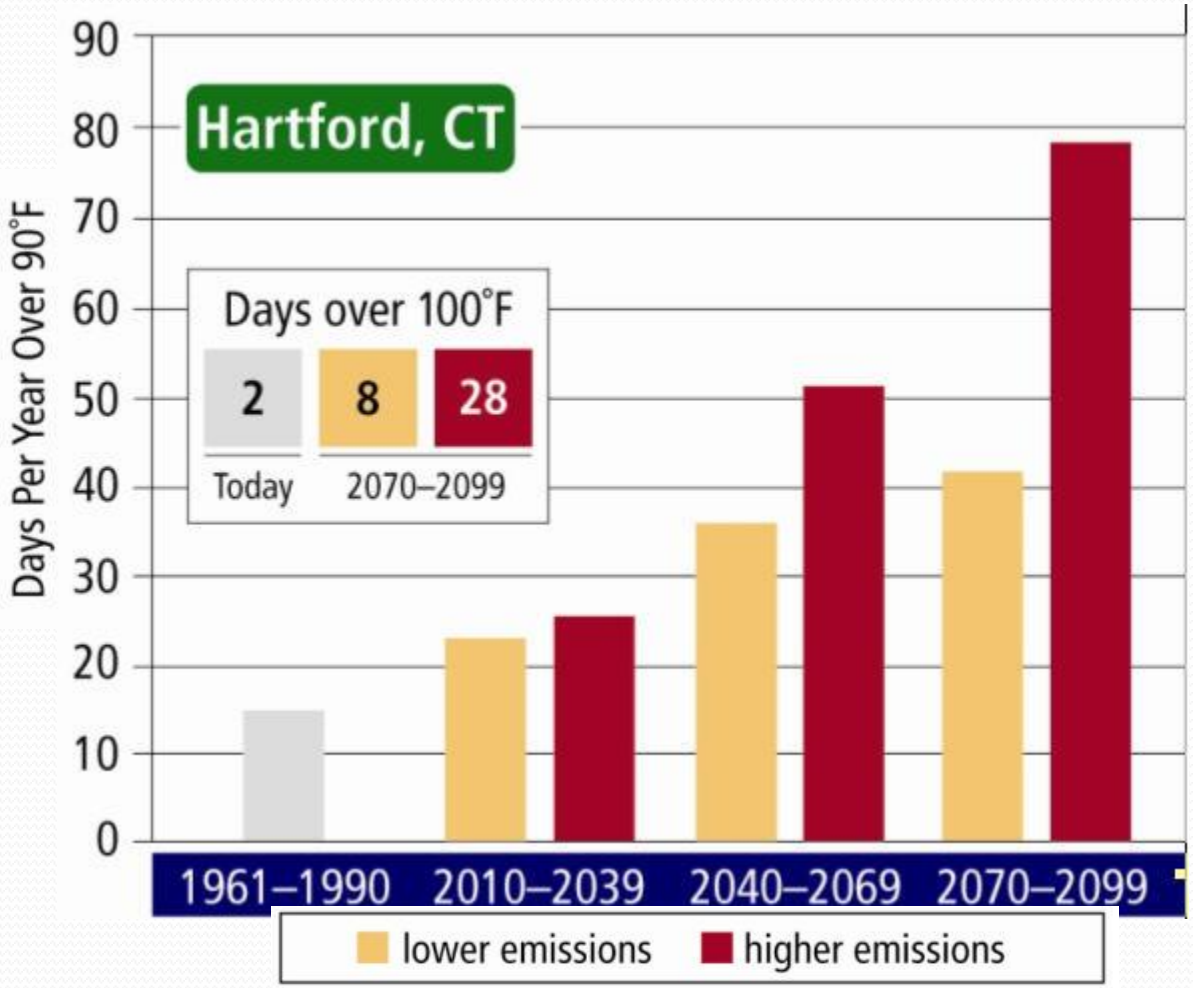
4 "Rapid ice-melt scenario" is based on acceleration of recent rates of ice melt in the Greenland and West Antarctic Ice sheets and paleoclimate studies.

Extreme Events

	Extreme Event	Baseline (1971-2000)	2020s	2050s	2080s
Heatwaves & Cold Events	# of days/year with maximum temperature exceeding:				
	90° F	14	23 to 29	29 to 45	37 to 64
	100° F	0.4[1]	0.6 to 1	1 to 4	2 to 9
	# of heat waves/year[2]	2	3 to 4	4 to 6	5 to 8
	Average duration (in days)	4	4 to 5	5 to 5	5 to 7
	# of days/year with minimum temperature below 32° F:	72	53 to 61	45 to 54	36 to 49
Intense Precipitation & Droughts	# of days per year with rainfall exceeding:				
	1 inch	13	13 to 14	13 to 15	14 to 16
	2 inches	3	3 to 4	3 to 4	4 to 4
	4 inches	0.3	0.2 to 0.4	0.3 to 0.4	0.3 to 0.5
	Drought occurs, on average[3]	~once every 100 yrs	~once every 100 to 100 yrs	~once every 50 to 100 yrs	~once every 8 to 100 yrs
Coastal Floods & Storms[4]	1-in-10 yr flood to reoccur, on average	~once every 10 yrs	~once every 8 to 10 yrs	~once every 3 to 6 yrs	~once every 1 to 3 yrs
	Flood heights associated with 1-in-10 yr flood (in feet)	6.3	6.5 to 6.8	7.0 to 7.3	7.4 to 8.2
	1-in-100 yr flood to reoccur, on average	~once every 100 yrs	~once every 65 to 80 yrs	~once every 35 to 55 yrs	~once every 15 to 35 yrs
	Flood heights associated with 1-in-100 yr flood (in feet)	8.6	8.8 to 9.0	9.2 to 9.6	9.6 to 10.5
	1 in 500-yr flood to reoccur, on average	~once every 500 yrs	~once every 380 to 450 yrs	~once every 250 to 330 yrs	~once every 120 to 250 yrs
	Flood heights associated with 1-in-500 yr flood (in feet)	10.7	10.9 to 11.2	11.4 to 11.7	11.8 to 12.6

CRI, pg. 20

Heatwaves and Temperature Extremes



In Yohe and Cole 2007 Presentation of NECIA 2007 Data

Assessing Risk

Risk Assessment Questions

- **Sensitivity of the Feature to Climate Change**
  - Known Climate Conditions Relevant to Features (Direct and Indirect; e.g., summer temperature, winter precipitation)
  - How do known climate conditions currently affect feature?
  - How exposed is the feature to the impacts of climate change?
  - Is the feature subject to existing stress, not caused by climate change?
  - How are known climate conditions projected to change?
  - Projected Impact of Changes to Systems in this planning area (without preparedness action)
  - Will climate change cause the demand for a resource to exceed its supply?
  - Does the system have limiting factors that may be affected by climate change?
  - What is the 'impact threshold', or the level at which sensitivity to climate conditions increase, associated with the system?
  - **Degree of Feature Sensitivity to Climate Change (Low, Medium, High)**

Preparing for Climate Change: A Guidebook for Local, Regional and State Governments 2007

Risk Assessment Questions Cont.

- **Adaptive Capacity of Feature**
  - Is the feature associated with the planning area already able to accommodate changes in climate?
  - Are there barriers to a feature's ability to accommodate changes in climate?
  - Are the features associated with a planning area already stressed in ways that will limit their ability to accommodate changes in climate?
  - Is the rate of projected climate change likely to be faster than the adaptability of the feature in this planning area?
  - Are there efforts under way to address impacts of climate change related to features in this planning area?
  - **Adaptive Capacity of Feature (Low, Medium, High)**

Assessing Risk

Risk Matrix*

		Likelihood of Occurrence			
		Low (1)	**Moderate (2)**	**High (3)**	**Virtually Certain/Already Occurring (4)**
Magnitude of Impact	**High (3)**	M (3)	H (6)	H (9)	H (12)
	Medium (2)	L (2)	M (4)	H (6)	H (8)
	Low (1)	L (1)	L (2)	M (3)	M (4)

*Risk equals the likelihood of occurrence multiplied by the magnitude of the impact, and is categorized as low (L), Medium (M) or High (H). Risk number determined by matrix multiplication.

Other Factors

- Interconnections
- Education
- Resources
- Identification of ongoing needs
  - E.g., future monitoring

Adaptation Subcommittee Workgroups

Agriculture- Commissioner Prelli (CT DoAG) and Steven Reviczky (CT Farm Bureau)
Infrastructure- Paul Stacey (CT DEP) and Denise Savageau (Town of Greenwich)
Natural Resources- Bill Hyatt (CT DEP) and Dr. Adam Whelchel (CT TNC)
Public Health- Pamela Kilbey-Fox (CT DPH) and Dr. Dennis McBride (Town of Milford)


Agriculture

Agriculture Workgroup

- First meeting April 6, 2009 at CT Farm Bureau
- Drafted *Connecticut Agriculture SWOT (Strengths, Weaknesses, Opportunities, Threats)*
- Drafted *Connecticut's Agricultural Impacts from Changing Climate*
- Brainstormed *Major Categories of Adaptation Response*
- Held Agriculture Risk Assessment Workshop, August 24, 2009

Agriculture Workshop Results

- Key Climate Drivers
  - Temperature
  - Precipitation
  - Air Quality
- Top 5 Most Imperiled Planning Areas or Features
  - Maple Syrup
  - Dairy
  - Warm Weather Produce
  - Shellfish
  - Apple and Pear Production

Agriculture Workshop Results Cont.

- Climate Change may hinder agricultural worker productivity
- Customers will be impacted (e.g., pick-your-own operations)
- Education will be important for adaptation
- Future monitoring and research are needed

Agriculture Workshop Results Cont.

- Opportunities
  - Longer Growing Season
  - Biofuels
  - Witch Hazel
  - Grape/Wine Production

Infrastructure

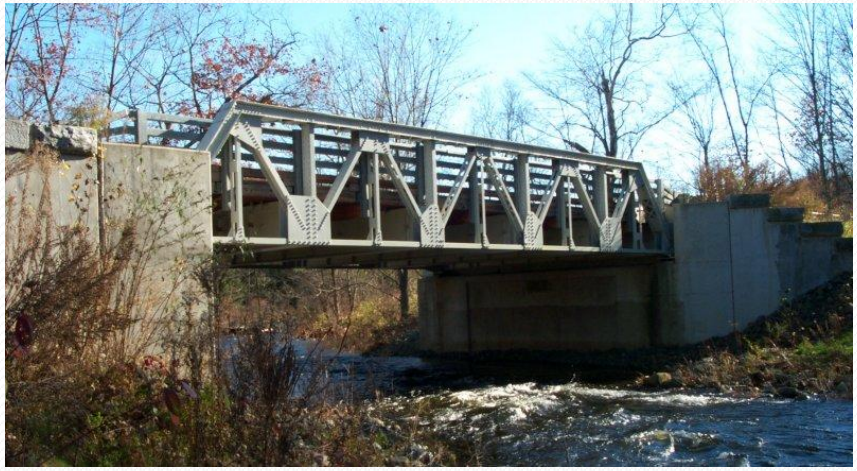
CT State Library

Infrastructure Workgroup

- First meeting May 13th
- Developed Infrastructure planning areas and associated features affected by climate change
- Noted resource needs and questions
- Listed climate change threats to Infrastructure
- Brainstormed a few possible adaptation strategies
- Held workshop on July 13, 2009

Infrastructure Impacts

- identified river and coastal flooding as primary impact
- investment in land-based best management practices (BMP) are essential to water quality and quantity
- natural defenses, such as barrier beaches and tidal marshes, provide a buffer against sea level rise and storm surges



Infrastructure Workshop Results

- Key Climate Drivers
  - Precipitation, including extreme precipitation events
  - Sea level rise, where applicable
- Most Imperiled Planning Areas
  - Coastal Flood Control and Protection
  - Dams and Levees
  - Stormwater
  - Transportation
  - Facilities and Buildings
  - Wastewater

Natural Resources

Process

- Natural Resources Work Group (NRWG) formed
- 18 terrestrial and aquatic habitat types identified as representative of the CT landscape.
- Facilitated workshop held to evaluate climate change impacts to these 18 habitats.
- Web survey used to assess impacts to species.

Key Findings:

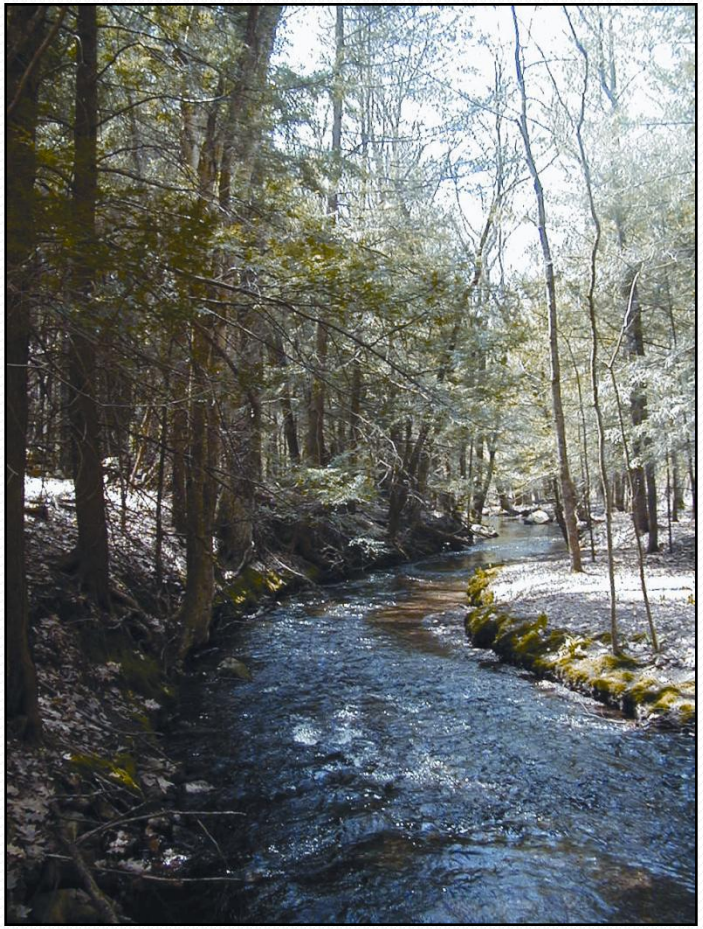
- **Fragmentation** eliminates biological corridors (aquatic and terrestrial) that link habitats, which will reduce the ability of plants and animals to migrate and adapt as the climate changes.
- **Invasive species** will likely increase with climate change (19 spp. specifically identified).
- **Forests**—the competitive advantage may shift to the more southerly oak-hickory mix over northern hardwoods (sugar maple, yellow birch, beech).
- **Increased water temperatures**—abundance and distribution of coldwater species may decline and warmwater species may increase.

Key Findings: continued …

- **Sea Level Rise and severe coastal storms**– may decrease shoreline habitat
- Some **bird species** will benefit from milder winters and extended breeding seasons, whereas others, such as northern species associated with forest habitats will decline.
- **Larger more adaptable mammal species** (e.g., deer) may benefit from climate change, whereas **smaller less mobile species** (e.g., New England cottontail) may become isolated and decrease.
- Species of **amphibians or invertebrates** associated with ephemeral aquatic habitats such as vernal pools are particularly vulnerable.
- Synchrony between **plants and native pollinators** may change.

Natural Resources Workshop Results

- Key Climate Drivers
  - Temperature
  - Precipitation
  - Sea Level Rise
- Most Imperiled Habitats
  - Cold Water Streams
  - Tidal Marsh
  - Open Water Marine
  - Beaches and Dunes
  - Freshwater Wetlands
  - Offshore Islands
  - Major Rivers
  - Forested Swamps



75 Species Identified as likely to Experience a Large Decline:

- Five species of Birds: including seaside sparrow and piping plover
- Three species of Reptiles & Amphibians: including bog turtle and diamond back terrapin
- 16 Invertebrate species: including lobster and Atlantis fritillary
- Six species of Fish: including brook trout and rainbow smelt
- One Mammal: least shrew
- 44 Plant species: including dwarf mistletoe and balsam fir

Public Health

Vector-Associated Diseases

- Climate drivers include temperature and precipitation
- Ticks
  - Lyme disease, Rocky Mountain Spotted Fever
- Mosquitoes
  - West Nile Virus
  - Eastern Equine Encephalitis

Food Safety

- Food borne illness
  - Extreme storm events will increase contaminants in runoff impacting shellfish
- Food supply and safety
  - Emerging food borne pathogens

Water Quality and Quantity

- Extreme storm events can increase occurrences of combined sewer overflows
- Rising sea levels could lead to salt intrusion of coastal ground water supplies
- Changing precipitation patterns can impact surface and ground water supplies

Air Quality & Extreme Heat

- Air Quality
  - Increased ozone exposure leads to asthma and allergen susceptibility
  - EJ groups, the elderly and people who work outside are most susceptible
- Extreme Heat
  - heat cramps
  - heat exhaustion
  - heat stroke
  - death

Public Health Infrastructure

- Extreme storm events may increase the need for emergency medical services
- Increases occurrence of >90° days may shift sheltering needs for homeless and elderly
- Environmental Justice Communities having the greatest needs may have inadequate access to services

Next Steps– Adaptation Strategies

- Impacts Report Posted on www.ctclimatechange.com in February
- Workgroups will determine adaptation strategies for the most imperiled planning areas or features
- Public comment on Adaptation Strategies Report in late June/July
- Adaptation Strategies Report due to the Legislature by mid-2010